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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 10/616,693
Filing Date: July 10, 2003
Appelant(s): DIGONNET, MICHEL J.F.

Bruce S. Itchkawatz, Reg, No. 47,677
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed February 2, 2007 appealing from the Office action mailed August 25, 2006.

(1) Real Party in Interest

The real party in interest of the present application is the Assignee, The Board of Trustees of the Leland Stanford Junior University.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

This appeal involves claim 1-15 and 49-57.

Claims 16-48 have been canceled.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

The following is a listing of the evidence (e.g., patents, publications, Official Notice, and admitted prior art) relied upon in the rejection of claims under appeal.

US Patent 4,773,759 A

US Patent 6,621,956 B2

Philip Russell, et al., Photonic Crystal Fibers, *Science* **299,** 358 (2003) (http://www.sciencemag.org/cgi/content/full/299/5605/358#otherarticles)

NEW GROUND(S) OF REJECTION

Examiner provides new grounds of rejection in response to Appellant's argument introduced in the Appeal Brief filed 2 February 2007. The new ground of rejection is applied to the claim 1 wherein the prior art of Farlex is replaced by Philip Russell review of the photonic crystal fiber state of the art in the Science publication to demonstrate the term "photonic crystal fiber" is a generic term expressed by one skilled in the art to referred to both species of solid-core photonic crystal fiber and hollow-core photonic crystal fiber.

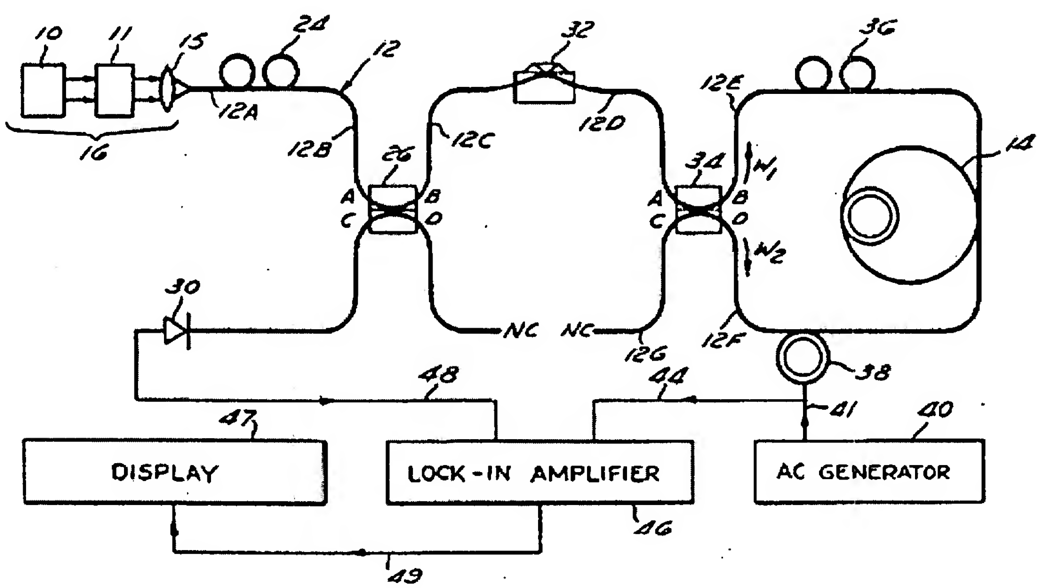
Claims 1-2, 10-15, 49-51-57 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bergh et al. (US 4, 773,759 "Bergh" hereinafter) in view of Greenway et al. (US 6,389,187 B1 "Greenway" hereinafter) and Philip Russell (Science, 17 January 2003 http://www.sciencemag.org/cgi/content/full/299/5605/358).

In terms of claim 1, Bergh discloses (Fig. 1) an optical sensor comprising:

a broadband light source ('10' and col. 5, lines 35-37) having an output that emits a first optical signal;

a first directional coupler (34) comprising at least a first port, a second port and a third port (A, C, B, D), the first port optically coupled to the light source to receive the first optical signal emitted from the light source, the first port optically coupled to the second port and to the third port such that the first optical signal received by the first port is split into a second optical signal output by the second port and a third optical signal output by the third port;

a fiber optically coupled to the second port and to the third port to form an optical loop such that the second optical signal and the third optical signal counter propagate through the fiber and return to the third port and the second port, respectively, and an optical detector (30) located at a position in the optical sensor to receive the counter propagating second and third optical signals after the second and third optical signals have traversed the fiber. Please note, Appellant's figures disclosed in the Specification corresponds one-to-one with the prior art figures of Bergh.



However, Bergh does not disclose a hollow photonic-bandgap fiber optically connecting the second and third port.

Greenway discloses an optical sensor comprising a light source; a directional coupler having at least three ports wherein the first port is coupled to the light source and split the signal and transmits them into a second and third port (col. 5, line 22-31); a photonic crystal fiber (col. 4, line 44-45) confining the counter propagating second optical signal and third optical signal within core (col. 5, line 67-col. 6, line 14); and an optical detector position to receive the signal from the second and third port (col. 4, line 58-col. 5, line17). Greenway's **motivation** for using a photonic crystal fiber as an alternative is for its compact size and reduced crosstalk characteristics (col. 4, lines 44-49).

However, Greenway does not explicitly disclose the photonic crystal fiber is a hollow core photonic crystal fiber or a solid core photonic bandgap fiber. The examiner would like to clarify that the term photonic crystal fiber is a generic term in the art of optical fiber to be understood as comprising both species of hollow and solid core photonic crystal fiber. In a review study by Philip Russell on the topic of photonic crystal fibers (Science, vol. 299, 17 January 2003), Russell discussed both species of photonic crystal fibers and referring to both generically as photonic crystal fiber (PCF). Russell cited the first solid core version was introduced was introduced in a private papers by Russell in 1991 wherein a periodic lattice of microscopic holes in the cladding glass provides light guidance in the fiber; the core is solid (page 358, first column, second paragraph). Then in 1995, Birks et al. published the "finger" plot Fig. 2(B) which indicates "hollow core guidance is indeed possible in the silica-air system." The first successfully produced hollow-core photonic crystal fiber was reported in 1999 (Fig. 2E and F) by Cregan et al. These discoveries of the solid core and the hollow-core PCF known in the art of optical fiber before the provisional filing date of the instant Appellant 20 August 2002,

such that one skilled in the arts as Russell refers to both specie generically as PCFs. Furthermore, Russell also points out the advantage of a hollow core fiber does not suffer as much bending loss as conventional fiber (Russell, page 360, 3rd column, 3rd paragraph). Examiner respectfully points out, this bending loss would occur in the loop (14) of Bergh's prior art. The advantage of having less bending loss in a photonic crystal fiber is presented by Knight et al. and Sorensen et al. in 1998 and 2001, respectively. Finally, Russell summarizes the known applications of PCF includes lasers, amplifiers, and ***sensors*** (presented by MacPherson et al. 2001, and Monro et al. 2001).

In view of the publication by Russell et al., examiner respectfully point out that at the time of Greenway et al.'s prior art, one having ordinary skill in the art would recognize the term ***photonic crystal fiber*** to be generically referred to both species of a ***hollow-core photonic crystal fiber*** and ***solid-core photonic crystal fiber***. The prior art of Bergh in view of Greenaway and Russell teach one skilled in the art to modify the conventional optical fiber loop (14), which is coupled by the second and third port, with a hollow-core photonic crystal fiber loop for the purpose of reducing bending loss, reducing cross-talk characteristics, low chromatic dispersion, and ultra-high nonlinearity characteristics; together all of the superior characteristics of a hollow-core photonic crystal fiber significantly improves the sensing operation that is taught by Bergh.

As to claim 2 and 10, as rejected above in claim 1, Greenway discloses the sensor comprises a broadband light source having a spectral distribution with a full width at half maximum (FWHM) of about 1 nanometer or larger, 18 nanometer (col. 7, lines 20-25). **The**

motivation for using a FWHM light source is to provide an intense source of broadband radiation to perform the sensing function.

Claims 3-9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bergh and Greenway as applied to claims 1 and 2 above, and further in view of Michal et al. (US 6,108,086 "Michal" hereinafter).

Bergh and Greenaway discloses all of the limitations of an optical sensor of claims 1 and 2; however, Bergh and Greenaway do not teach the light source mean wavelength is stable at least ±0.1 - ±100 parts per million.

Michal disclose an optic gyroscopes comprising a broadband source comprising a super luminescent fiber source, erbium doped fiber, having bandwidth of 8 nm reduces the centroid wavelength shift to less than 0.1 ppm from 500 ppm for the purpose of preserving the integrity of the broadband fiber light signal. In harsh environments, when Erbium doped fiber is exposed to ionizing radiation, the broadband fiber source loses the wide spectral width, therefore maintaining the light source mean wavelength stability at the various range from ±0.1 - ±100 parts per million is critical in preserving the signal integrity and the broad spectrum of the light source.

Since Bergh, Greenaway, and Michal are all from the same field of endeavor, the purpose disclosed by Michal would have been recognized in the pertinent art of Bergh and Greenaway. It would have been obvious at the time the invention was made to a person having ordinary skill in the art to provide bandpass filters centered at 1557 nm having a bandwidth of 8 nm reduces the centroid wavelength shift to less than 0.1 ppm from previously observed stability at 500 ppm.

The motivation for maintaining the centroid wavelength stability at fractional ppm allows the broadband light source to maintain the broad spectrum of light since Erbium doped fiber is sensitive to exposure to ionizing radiation.

Regarding claims 11-15, as rejected above, Bergh discloses the optical sensor further comprising an amplitude and frequency modulator that is external to the light source (38);

Regarding claims 49-51, as rejected above, Bergh teaches a second directional coupler (26) coupling to the first port of the first directional coupler, and the third port of the second directional coupler is optically coupled to a non-reflective termination; wherein a polarizer (32) is optically connected to the second port of the second directional coupler and to the first port of the first directional coupler, wherein the second directional coupler comprises a fourth port that is optically coupled to a photodetector (30).

As to claim 52-57, as rejected above, Bergh in view of Greenaway does not explicitly teach the limitations of claims 52-57. However, Russell teach the guided mode in the core microstructure of the PCF acts as a polarization maintaining fibers (page 360, 1st paragraph). **The motivation** for utilizing PCF as a polarization maintaining fiber is the ease of fiber manufacturing process. Unlike the conventional bow-tie or Panda polarization maintaining fibers which require two different glasses, each with different thermal expansion coefficient. PCF are more suited since the birefringence is insensitive to temperature, thus when applied in a sensing system would be less susceptible undesired temperature variation.

(10) Response to Argument

i. Appellant argues the Farlex reference is improperly applied since anyone with access to the Internet can edit the reference, thus not a proper reference by one having ordinary skill in the art. This argument is made for the first time in the Appeal Brief, therefore Examiner provided new grounds of rejection, replacing the prior art of Farlex with Russell, applied to claim 1 (MPEP §1207.03) with the prior art of Bergh in view of Greenaway and in further view of Russell et al. The rejection made above clearly traced the discoveries of photonic crystal fibers and the two separate species of a solid-core photonic crystal fiber and a hollow-core photonic crystal fiber. The review made by Russell, in totality, teaches the state of the art of photonic crystal fiber and that the term "photonic crystal fiber" is well understood by one having ordinary skill in the art to encompass both species of a solid-core and hollow-core.

ii. Appellant argues the limitations of claim 1 is not taught or suggested by Bergh in view of Greenaway. Examiner provided new grounds of rejection applied to claim 1 wherein the prior arts in combination of Bergh, Greenaway, and Russell teach that, during the time of the filing date of the instant application, the public has the knowledge of an optical sensor which utilizes photonic crystal fibers. Russell cited the publication of W. N. MacPherson et al. published in 2001 and T. M. Monro et al. in 2001. Thus, the combination of prior arts of Bergh, Greenaway, and Russell would teach one having ordinary skill in the art the Appellant's claimed invention.

The rejection made above clearly traced the discoveries of photonic crystal fibers and the two separate species of a solid-core photonic crystal fiber and a hollow-core photonic crystal fiber. The review made by Russell, in totality, teaches the state of the art of photonic crystal

fiber and that the term "photonic crystal fiber" is well understood by one having ordinary skill in the art to encompass both species of a solid-core and hollow-core.

Appellant also argues that Greenaway discloses a "broad term of photonic crystal fiber which includes the optical fibers with one or more hollow cores, one or more solid cores, combinations of hollow cores and solid cores, and cores filled with various solid or gaseous material" (Appeal Brief, page 7), which admits that Appellant acknowledge the term "photonic crystal fiber" also include the species of a hollow-core fiber. Furthermore, Appellant argues that Greenaway teaches a core filled with gaseous materials does not provide prima facie case of obviousness for claim 1. Examiner respectfully points out that Appellant's claim 1 does not further limits whether the hollow-core photonic crystal fiber is filled or not filled with any material. Therefore, by Appellant's acknowledgment of the various species that Greenaway's disclosed term of "photonic crystal fiber" could include the species of a hollow-core filled with gaseous materials reads upon the current claim limitation. Nevertheless, the new grounds of rejection which includes the prior art of Russell also discloses the prior arts of MacPherson and Monro publication which teaches solid core and hollow core photonic crystal fiber used in a sensor system.

iii. Appellant argues there is no suggestion or motivation to modify Bergh in view of Greenaway and Farlex. Examiner provided new grounds of rejection to address the argument presented for the first time in this Appeal Brief (MPEP §1207.03). The combination of Bergh, Greenaway, and Russell, the motivations to combine the known sensor by Bergh and the sensor taught by Greenaway is clearly taught by Russell. Russell outlined the known art of conventional fiber and the improvement in the art of laser and sensor with the newly discovered

solid core and hollow core photonic crystal fiber. Russell discloses that photonic crystal fibers "could carry more power, could be used for sensing, could act as a better host for rare-earth ions, had multiple cores, had higher nonlinearities, or had high birefringence or widely engineerable dispersion" (Russell page 358, 3rd column, 2nd paragraph). These characteristics are motivations for one skilled in the art to modify Bergh prior art with the disclosure of Greenaway sensor that utilizes photonic crystal fibers.

Regarding arguments to claims 2, 10-15, and 49-57, Appellant mainly argues the deficiency of the prima facie case of obviousness of claim 1 collapses the prima facie case of obviousness of the dependent claims. Appellant does not argue any prior art errors, which lacks the teaching of the dependent claimed limitations. Examiner provided new grounds of rejection applied to claim 1 (MPEP §1207.03) with the prior art of Bergh in view of Greenaway and in further view of Russell et al. The rejection made above clearly traced the discoveries of photonic crystal fibers and the two separate species of a solid-core photonic crystal fiber and a hollow-core photonic crystal fiber. The review made by Russell, in totality, teaches the state of the art of photonic crystal fiber and that the term "photonic crystal fiber" is well understood by one having ordinary skill in the art to encompass both species of a solid-core and hollow-core. Furthermore, Russell discloses the motivations to combine the art of Bergh, Greenaway, and Michal by disclosing photonic crystal fiber is superior to conventional optical fiber since photonic crystal fiber "could carry more power, could be used for sensing, could act as a better host for rare-earth ions, had multiple cores, had higher nonlinearities, or had high birefringence or widely engineerable dispersion" (Russell page 358, 3rd column, 2nd paragraph). These characteristics are motivations for one skilled in the art to modify Bergh prior art with the disclosure of Greenaway

and Michal, which discloses sensors that utilize photonic crystal fibers. Therefore, Examiner finds Appellant's argument of claim 1 is nonobvious under 35 U.S.C § 103(a) is not persuasive. Examiner also finds Appellant's argument of the dependent claims 2, 10-15, and 49-57 is nonobvious under 35 U.S.C § 103(a), since claim 1 is nonobvious, is not persuasive.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

This examiner's answer contains a new ground of rejection set forth in section **(9)** above. Accordingly, appellant must within **TWO MONTHS** from the date of this answer exercise one of the following two options to avoid *sua sponte* **dismissal of the appeal** as to the claims subject to the new ground of rejection:

Maintain appeal. Request that the appeal be maintained by filing a reply brief as set forth in 37 CFR 41.41. Such a reply brief must address each new ground of rejection as set forth in 37 CFR 41.37(c)(1)(vii) and should be in compliance with the other requirements of 37 CFR 41.37(c). If a reply brief filed pursuant to 37 CFR 41.39(b)(2) is accompanied by any amendment, affidavit or other evidence, it shall be treated as a request that prosecution be reopened before the primary examiner under 37 CFR 41.39(b)(1).

Extensions of time under 37 CFR 1.136(a) are not applicable to the TWO MONTH time period set forth above. See 37 CFR 1.136(b) for extensions of time to reply for patent

applications and 37 CFR 1.550(c) for extensions of time to reply for ex parte reexamination proceedings.

Respectfully submitted,
EDC
Erin D. Chiem

Assistant Examiner

Frank G. Font
Supervisory Patent Examiner
Technology Center 2800

DAVID S. BLUM
TQAS

A Technology Center Director or designee must personally approve the new ground(s) of rejection set forth in section (9) above by signing below:

Janice A. Falcone
JANICE A. FALCONE
DIRECTOR
TECHNOLOGY CENTER 2800